

## **Title: Slopey Math**

### **Brief Overview:**

This is an introductory unit designed to give students a concrete understanding of what slope really means through the use of the TI-83+ graphing calculator and Calculator Based Laboratory (CBL)2. The students will model different situations generated by the CBL motion detector. The students will discover and interpret important concepts regarding slope, the y-intercept, and the slope-intercept form of a linear equation.

### **NCTM 2000 Principles for School Mathematics:**

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

### **Links to NCTM 2000 Standards:**

- **Content Standards**

#### **Algebra**

Students will understand patterns, relations, and functions and use mathematical models to represent and understand quantitative relationships.

#### **Data Analysis and Probability**

Students will formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

- **Process Standards**

- Problem Solving**

- Students will solve problems that arise in mathematics and other contexts. They will apply and adapt a variety of appropriate strategies to solve problems.

- Reasoning and Proof**

- Students will make and investigate mathematical conjectures.

- Communication**

- Students will organize and consolidate their mathematical thinking through communication. They will communicate their mathematical thinking coherently and clearly to peers, teachers, and others. They also will use the language of mathematics to express mathematical ideas precisely.

- Connections**

- Students will recognize and use connections among mathematical ideas. They will understand how mathematical ideas interconnect and build on one another to produce a coherent whole. Lastly, they will recognize and apply mathematics in context outside of mathematics.

- Representation**

- Students will create and use representations to organize, record, and communicate mathematical ideas. They will select, apply, and translate among mathematical representations to solve problems. Students also will use representations to model and interpret physical, social, and mathematical phenomena.

**Links to Maryland High School Mathematics Core Learning Units:**

- Functions and Algebra**

- **1.1.1**

- The student will recognize, describe and extend patterns and functional relationships that are expressed numerically and algebraically.

- **1.1.2**

- The student will represent patterns and functional relationships in a table, as a graph, and/or by mathematical expression.

- **1.2.1**

- The student will determine the equation for a line.

**Grade/Level:**

Grades 9-12, Concepts of Algebra, Algebra I & II

**Duration/Length:**

Two to three 45 minutes class periods

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Understanding the (x,y) coordinate plane
- Understanding ordered pairs and their relationship to a graph
- Being capable of reading and understanding a table

**Student Outcomes:**

Students will:

- create graphs using a CBL unit with a motion detector to model real-world situations.
- be able to use learned knowledge to duplicate graphs using the CBL unit with a motion detector.
- be able to draw conclusions about rate of change/slope and the y-intercept as a result of their discoveries using the CBL unit.
- use the TI-83/TI-83+ to investigate the rate of change/slope and the y-intercept of linear equations.
- be able to create ratios using two ordered pairs from the table function of the TI-83/TI-83+.
- be able to use these ratios to understand how to calculate slope from two points by comparing these ratios with the coefficient of x (slope) in the slope-intercept equations in the y= area of the calculator.
- be able to define the y-intercept and slope of a linear graph.
- be able to recognize and name the y-intercept and slope given a linear equation in slope-intercept form.
- be able to create a linear equation in slope-intercept form to model a given graph.

**Materials/Resources/Printed Materials:**

- Classroom set of TI-83 or TI-83+ graphing calculators.
- Ideally, teacher should have one CBL unit with a motion detector or a Ranger unit per three students.
- Student activity sheets, homework sheets, and assessment sheets

**Development/Procedures:**

Teacher, following the instructions found in each module Teacher Guide, should follow the modules in order, inserting them within their individual county curriculum guide, using them as introductions to the concepts of slope, y-intercept, and linear equations in slope-intercept form.

**Day 1:** CBL2 Module

**Day 2:** TI-83+ Module

**Day 3:** Application/Interpretation Module

**Assessment:**

Each module contains its own assessment segment. An effort was made to keep the assessment portion brief, as this is an introductory lesson unit. Homework worksheets are included in modules one and two, while a short quiz concludes module three. Brief constructed response questions (BCR's) and extended constructed response questions (ECR's) are included in the assessment segments.

**Extension/Follow Up:**

As an introductory unit, extensions would be appropriate within the curriculum structure of each individual county.

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## 1.1

### Teacher's Guide to the CBL Section of Exploring Slope and Y-Intercept

The CBL section is designed with the intent of having the students explore the concrete concept of slope and y-intercept through experimentation. There are three areas in this section.

The first is a **warm up** that can be used as a teacher directed demonstration, or can be carried out by students in a small group setting. The purpose is two – fold; first to get everyone comfortable with the CBL (Ranger) equipment; and the other is to run through a series of activities to understand the purpose of the lesson.

The second is a **student activity sheet** to be carried out in small groups; ideally three to a group so everyone would have a task. In questions one through six, one would carry out the actual task at hand walking toward or away from the detector at a specified speed (fast or slow), another would work the CBL, and another would be responsible for recording the data. These tasks should be rotated so that everyone would have each task twice. Then the students, in their respective groups, would discuss questions seven through ten. Each group would work on question eleven independently. Then a representative from each group could share their results on a pre-made overhead that already had a blank grid on it.

The third piece to the CBL section would be the **assessment: describing patterns of change**. This is designed as a homework assignment, but could very easily be adapted for a quiz, depending on what the students were able to complete on the **student activity sheet**. If the students only had time to simulate the six experiments using the CBL, then questions seven through eleven could certainly be answered at home since no graphing calculator or CBL is needed.

The **warm up** instruction sheet was designed as a teacher instruction sheet, but could certainly be modified to hand out to your students. The **student activity sheet**, and **assessment: describing patterns of change**, have answer keys included for your convenience.

Please note that CBLs with the motion detector probe can easily be substituted with a RANGER, which is much less expensive. In addition, feel free to use your discretion on group size depending on your class size and their social interaction skills.

## 1.2

### Warm Up: Class Activity/Introduction to the Motion Detector

#### To begin:

Plug motion detector into the dig/sonic port.

1. **Physics APP.**
2. **Set up probes** and follow directions until the main menu reappears.
3. **Collect data.**
4. **Monitor input.**

What units is the motion detector measuring in?

How often is the detector taking measurements?

Hold the motion detector against the floor, and then at the top of your head facing the floor.

How far away is the person next to you?

How far away is the front of the room?

How can you account for any "blips" or sudden inconsistencies in the readings?

5. + to return to the data collection menu
6. **Time graph.**  
Time between samples = 0.1 seconds  
Number of samples = 100
7. **Use time setup** (unless you have made a mistake, in which case, choose **Modify setup**).
8. **Live display.**  
y min = 0  
y max = 4  
y scl = 0.5

Walk back and forth in front of the motion detector.

When finished, the graph will rescale, and automatically be in **Trace** mode.

Press ENTER, and repeat if necessary.

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#### In Time Graph, try to make . . .

a horizontal line

a steadily increasing line

a quickly decreasing line

a graph that at first decreases slowly, and then more quickly

a graph that first increases, then decreases, with no curves

a graph that decreases, then increases, with no curves

a graph that looks like a wave

a graph with a slope of 1

a graph with a slope of - 1

### 1.3

**Graph Match:** (This function works best when the calculator is projected)

Return to the main menu.

1. **Collect data.**
  2. **Graph Match.** (This option is only available when the motion detector is plugged in.)
  3. **Distance Match.**
- 

**Fitting a line by hand:**

1. **Collect data.**
2. **Monitor input.**
3. **Time graph.**  
Time between samples = 0.1 seconds  
Number of samples = 100
4. **Use time setup** (unless you have made a mistake, in which case, choose **Modify setup**).
5. **Live display.**  
y min = 0  
y max = 4  
y scl = 0.5

Try to make a straight line.

Return to the main menu.

**Quit** Physics APP.

6. **STAT**
7. **EDIT**

L1 contains time, L4 is distance.

Find the slope between the first and second points.

Find the slope between the second and third.

Find the slope between the third and fourth.

What do these values represent in the context of the problem?

Were they consistent? Would you expect them to be? Why or why not?

8. **Quit** Physics
9. **Y1 = AX + B**
10. **Physics APP.**
11. **Analyze.**
12. **Add model.**

## 1.4

The time graph will be briefly displayed, along with a line whose A and B values are the last A and B from the calculator's memory. You will have the option of adjusting A and B until the line fits the data. Notice that the last A or B value is displayed before you enter a new one.

What does the slope represent in the context of the problem?

What does the y - intercept represent in the context of the problem?

If you continued at the same speed, where does the model predict you would be after 15 seconds?

## 1.5

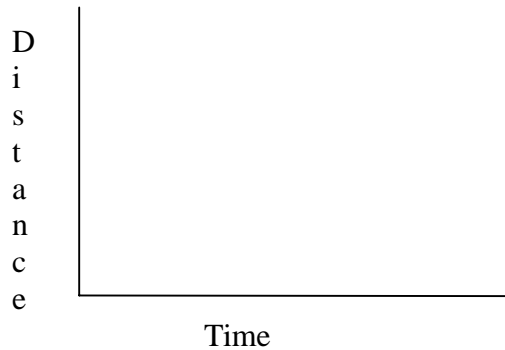
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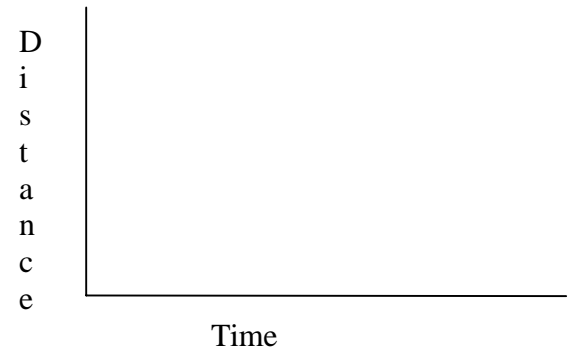
### STUDENT ACTIVITY SHEET A: Patterns of Change in Distance/Time Graphs

On the grids below, sketch the graph generated by the CBL Motion detector for each of the following situations.

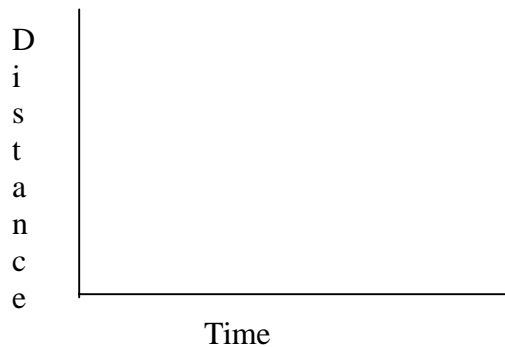
1. Walking at a constant rate (speed) away from the motion detector.



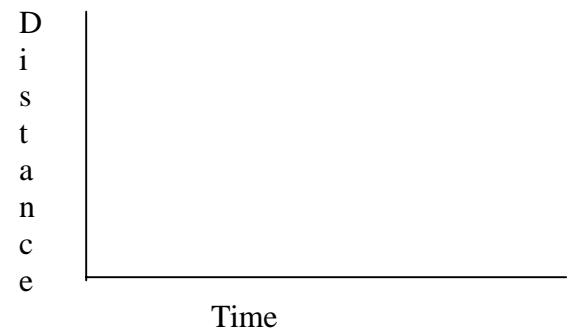
2. Walking at a constant rate toward the motion detector.



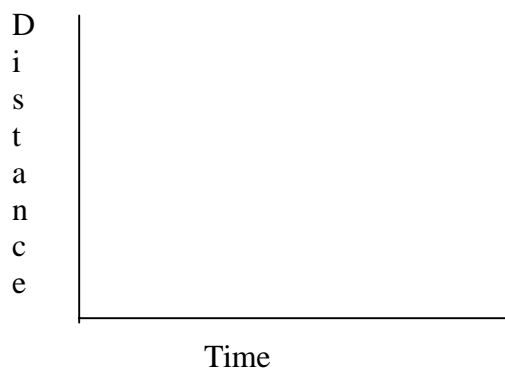
3. Walking at a non-constant rate (going faster and faster) away from the motion detector.



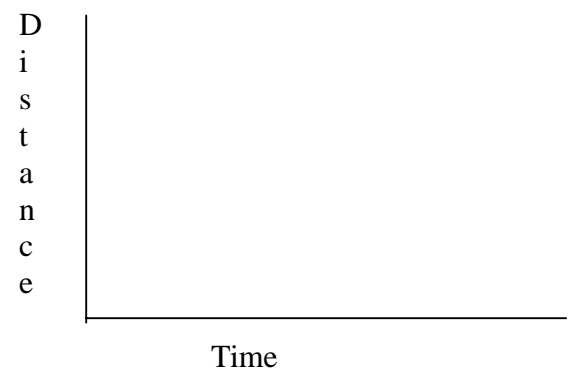
4. Walking at a non-constant rate (going slower and slower) away from the motion detector.



5. Walking at a non-constant rate moving both towards and away from the motion detector.



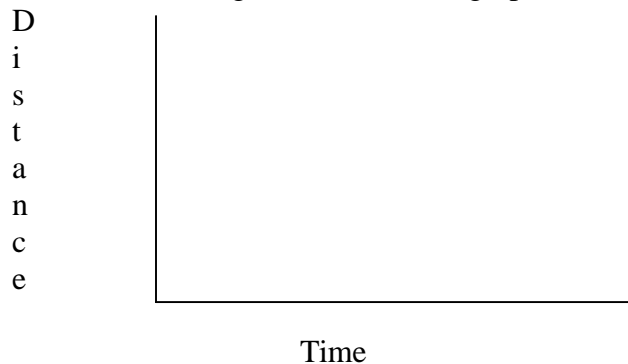
6. Walking at a non-constant rate (going slower and slower) towards the detector



## 1.6

7. How did the graphs of the constant rate walks differ from those of the non-constant rate walks?
8. How can you tell from the graph whether a student is walking toward or away from the detector?
9. How do the graphs of walks in which the rate is increasing differ from those in which the rate is decreasing?
10. Describe the motion in front of the detector that would generate a horizontal line for the distance/time graph.
11. Watch as one student walks in front of the detector with the calculator screen turned off.

- Sketch a graph of the distance/time relationship for this student's walk without looking at the calculator graph.



- Compare your graph to the graphs of other students in your class.
- Compare your graph to the graph generated on the calculator.

## 1.7

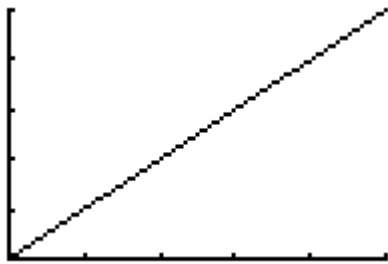
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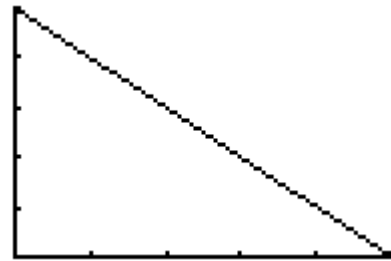
### STUDENT ACTIVITY SHEET A: *Answer Key* Patterns of Change in Distance/Time Graphs

On the grids below, sketch the graph generated by the CBL Motion detector for each of the following situations.

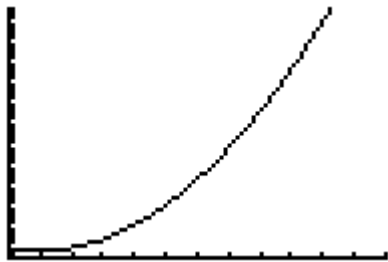
1. Walking at a constant rate (speed) away from the motion detector.



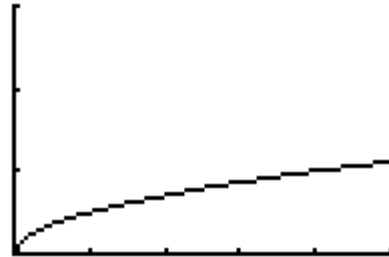
2. Walking at a constant rate toward the motion detector.



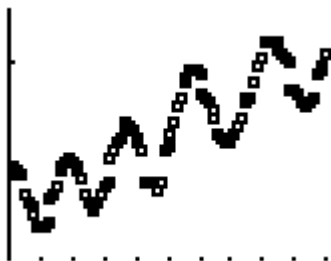
3. Walking at a non-constant rate (going faster and faster) away from the motion detector.



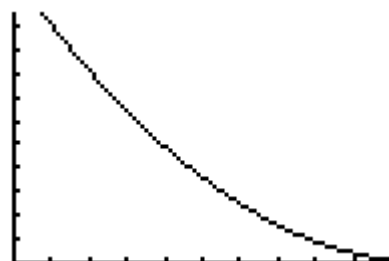
4. Walking at a non-constant rate (going slower and slower) away from the motion detector.



5. Walking at a non-constant rate moving both towards and away from the motion detector.



6. Walking at a non-constant rate (going slower and slower) towards the motion detector.



## 1.8

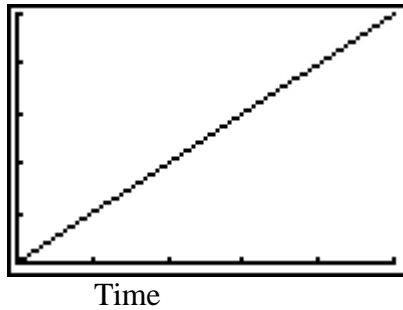
7. The graphs of the constant rate walks differ from those of the non-constant rate walks in that the constant rate walks are straight lines and the non-constant rate walks are curves.
8. You can tell from the graph whether a student is walking toward or away from the detector by whether or not the graph is increasing or decreasing. If the graph is increasing, then the student is walking away from the detector. If the graph is decreasing, then the student is walking toward the detector.
9. The graphs of walks in which the rate is increasing differs from those in which the rate is decreasing in that the graph increases or decreases more and more quickly with increasing rates and decreases less and less quickly with decreasing rates.
10. There would be no motion in front of the detector that would generate a horizontal line for the distance/ time graph.
11. ANSWERS WILL VARY.

## 1.9

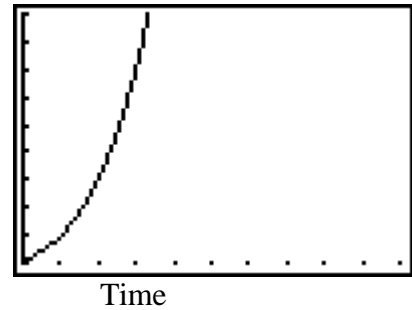
### Assessment Describing Patterns of Change

Each of the following graphs was generated when a student walked in front of a motion detector. Describe the student's walk in each case.

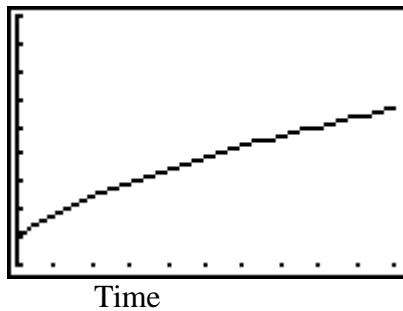
1. Dist



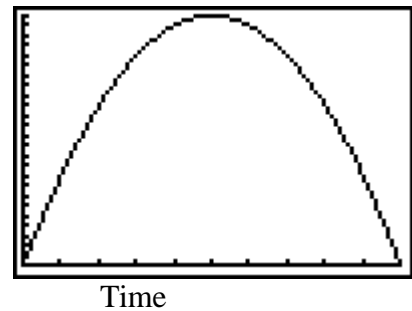
2. Dist



3. Dist

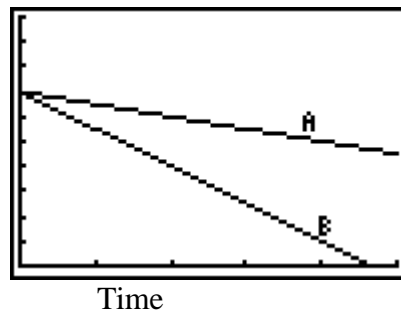


4. Dist



The grid below contains the distance/time graph for two different students who walked in front of a motion detector.

Dist



5. Give at least one reason how the two students' walks are the same?
6. How are the two students' walks different?

## 1.10

### Assessment *Answer Key: Describing Patterns of Change*

1. The student is walking at a constant rate (speed) away from the motion detector.
2. The student is walking at a non-constant rate (going faster and faster) away from the motion detector.
3. The student is walking at a non-constant rate (going slower and slower) away from the motion detector.
4. The student is walking at a non-constant rate (going slower and slower) away from the motion detector; then back toward the motion detector at a non-constant rate (going faster and faster).
5. Possible accepted responses:
  - The two students started in the same place.
  - The two students were walking at a constant rate.
  - The two students were walking toward the detector.
6. The two students' walks were different in that Student B is walking at a faster rate than Student A.

## 2.0

### **Slopy Math: Module 2 Teacher's Guide**

#### **Objectives:**

The students will be able to:

- use the TI-83/TI-83+ calculator to display the graphs of linear equations.
- explain how the appearance of linear graphs change when as the coefficient of X or constant changes.

#### **Materials:**

Student Activity Worksheet  
Homework Sheet  
TI-83/TI-83+ Calculator

#### **Development/Procedures:**

The teacher should lead the students in a discussion on how to use the TI-83/TI-83+ calculator to display the graphs of linear equations. The discussion should also include how to retrieve and read the tables create by the graphs of linear equations. The warm-up provides students with the opportunity to access their prior knowledge of linear equations and plotting points on the coordinate plan. The module also includes a Student Activity Worksheet, and a Homework Sheet. At the conclusion of the activity the teacher should lead the class in a discussion of the graphs of the linear equations. The homework will serve as an assessment, and to strengthen the skills developed through the activity.

#### **Assessment:**

The students will be assessed through their independent homework assignment.

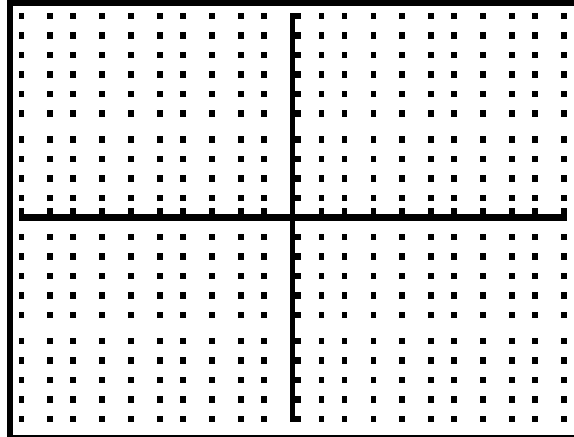
## 2.1

### Warm Up

1. Evaluate  $y = x + 2$  at  $x = 5$ ;  $x = -2$ ;  $x = 1$ ;  $x = -7$ ;  $x = 0.5$ ;  $x = -0.5$ ;  $x = -1$  and  $x = 0$ .  
Arrange the data in the table provided below.

X	Y

2. Plot the ordered pairs  $(2, 3)$ ,  $(-6, 0)$ ,  $(0,0)$ , and  $(-4, -8)$  on the graph below:



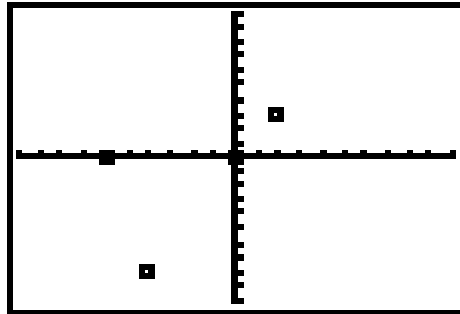
## 2.2

### Warm Up Answer Key

1. Evaluate  $y = x + 2$  at  $x = 5$ ;  $x = -2$ ;  $x = 1$ ;  $x = -7$ ;  $x = 0.5$ ;  $x = -0.5$ ;  $x = -1$  and  $x = 0$ .  
Arrange the data in the table provided below.

X	Y
5	7
-2	0
1	3
-7	-5
0.5	0.5
-0.5	1.5
-1	1
0	2

2. Plot the ordered pairs  $(2, 3)$ ,  $(-6, 0)$ ,  $(0,0)$ , and  $(-4, -8)$  on the graph below:



## 2.3

### PROCEDURE FOR USING “Y=”

- Press [Y=].
- For  $Y_1$  input  $X+0$ ; (locate X using the [X, T,  $\Theta$ ,  $n$ ] key).
- For  $Y_2$  input  $5X+0$ .
- For  $Y_3$  input  $X+4$ .
- For  $Y_4$  input  $2X-3$ .
- For  $Y_5$  input  $0.5X+0$ .

```

Plot1 Plot2 Plot3
\Y1=X+0
\Y2=5X+0
\Y3=X+4
\Y4=2X-3
\Y5=0.5X+0
\Y6=
\Y7=

```

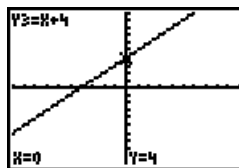
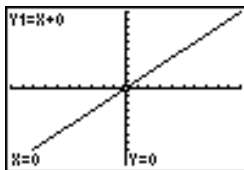
- Press [<] to move the cursor to [=], press [ENTER] to turn the graphs on or off. In the window below  $Y_1$  and  $Y_3$  are turned on.

```

Plot1 Plot2 Plot3
\Y1=X+0
\Y2=5X+0
\Y3=X+4
\Y4=2X-3
\Y5=0.5X+0
\Y6=
\Y7=

```

- Press [ZOOM] select 5: [ZSQAURE]. Press [GRAPH] to display the graphs, as you turn on each graph one at a time.



## PROCEDURE FOR USING TABLE SETUP

- a. Press [2<sup>nd</sup>] [WINDOW] to display the TABLE SETUP screen.
- b. Press (-) **10** [ENTER] to set **TblStart=-10**. Press **1** [ENTER] to set **ΔTbl=1**(the increment, or step for the independent variable).
- c. Press [ENTER] to select **Indpnt: Auto**.
- d. Press [ENTER] to select **Depend: Auto**.
- e. Press [2<sup>nd</sup>] [GRAPH] to display the table screen.

TABLE SETUP	
TblStart=-10	■
ΔTbl=1	
Indpnt:	Auto Ask
Depend:	Auto Ask

- f. Press [V] until you see the sign changes in the value of  $Y_1$ . How many sign changes occur, and at what  $X$  values?

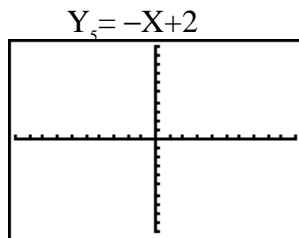
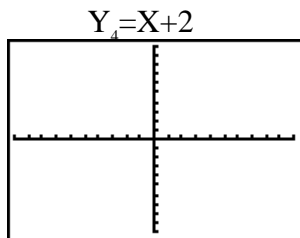
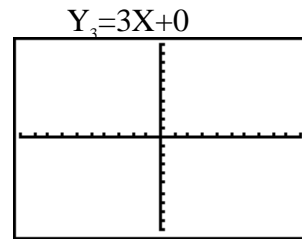
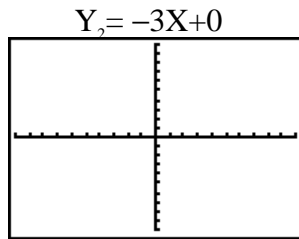
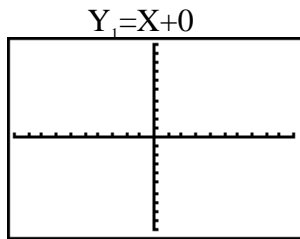
X	Y <sub>1</sub>	
-3	-3	
-2	-2	
-1	-1	
0	0	
1	1	
2	2	
3	3	
X=3		

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### STUDENT ACTIVITY WORKSHEET

1. Input the following linear equations into [Y=], display the graph of each, and reproduce them on the graphs provided below.



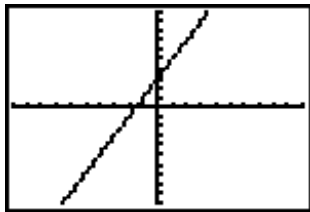
2. Discuss the similarities and differences in the graphs above?
3. How are the lines for the linear equations with a negative number in front of X different from the ones with positive numbers in front of X?

4. Select two X values and their corresponding Y values from the table for  $Y_2=5X+0$  below. Find the difference of the X values. Repeat this step with the Y values. Construct a ratio using these values by placing the difference in the Y values over the difference in the X values. Repeat this exercise with two different sets of X and Y values, and explain your findings.

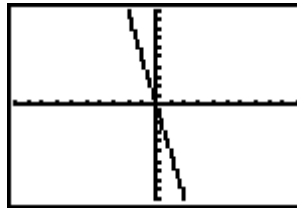
X	Y <sub>2</sub>	
-3	-15	
-2	-10	
-1	-5	
0	0	
1	5	
2	10	
3	15	
Y <sub>2</sub> = -15		

5. Which of the graphs below contains the line of a linear equation in which the number in front of X is a negative number?

a)

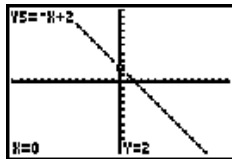
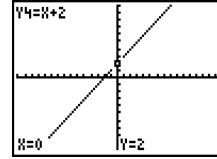
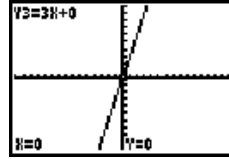
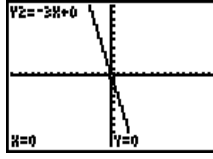
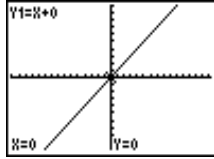


b)



## STUDENT ACTIVITY WORKSHEET: KEY

- Input the following linear equations into [Y=], display the graph of each, and reproduce them on the graph provided below.



- Discuss the similarities and differences in the graphs above?

**Student answers may vary. Example: In the first, third and fourth graphs the lines are going in the same direction. The lines on the second and third graphs appear to be the opposite or mirror reflection of each other.**

- How are the lines for the linear equations with a negative number in front of X different from the ones with positive numbers in front of X?

**The lines for linear equations with a negative number in front of X decrease from left to right, while the lines for linear equations with a positive number in front of X increase from left to right.**

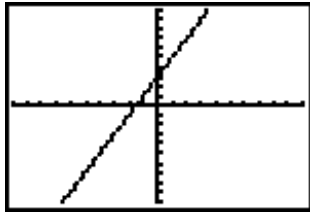
- Select two X values and their corresponding Y values from the table for  $Y_2 = 5X + 0$  below. Find the difference of the X values. Repeat this step with the Y values. Construct a ratio using these values by placing the difference in the Y values over the difference in the X values. Repeat this exercise with two different sets of X and Y values, and explain your findings.

X	Y <sub>2</sub>	
-3	-15	
-2	-10	
-1	-5	
0	0	
1	5	
2	10	
3	15	
Y <sub>2</sub> = -15		

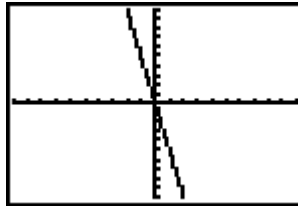
**Student answers will vary. Example: Using the X values -3 and 2, and their corresponding Y values -15 and 10.**

5. Which of the graphs below contains the line of a linear equation in which the number in front of  $X$  is a negative number?

a)



b)

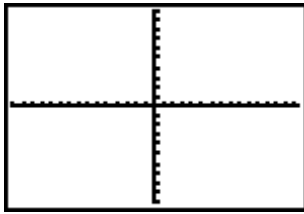


Name: \_\_\_\_\_

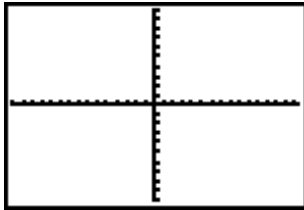
Date: \_\_\_\_\_

### HOMEWORK ACTIVITY WORKSHEET

1. Plot the ordered pairs in the tables below in the graphs that have been provided. State if the graphs formed by plotting the ordered pairs are linear.



X	Y
1	1
2	4
0	0
-1	1
-2	4

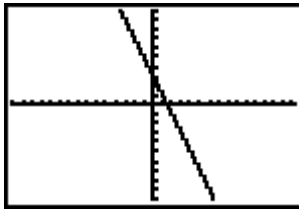


X	Y
1	4
2	8
0	0
-1	-4
-3	-12

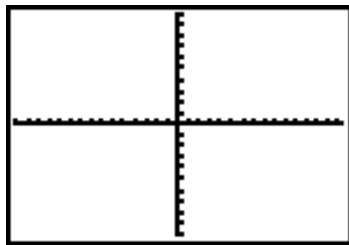
2. Evaluate the linear equation  $Y=2X+3$  using the values in the table below. Select two X values and their corresponding Y values. Find the difference between the two X values repeat this step with the Y values. Create a fraction by placing the difference in the Y values over the X values. Select two more X values and their corresponding Y values, and explain your findings.

X	Y
3	
5	
0	
-4	
-6	

3. Which of these equations  $Y=2X+3$  or  $Y=-2X+3$  is represented by the graph below.



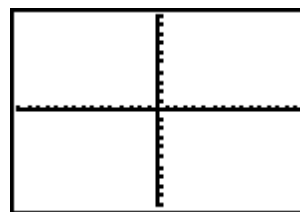
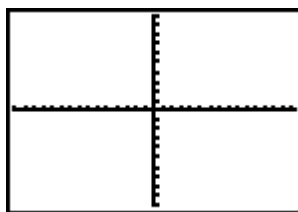
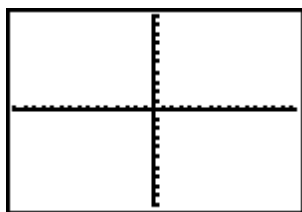
4. Graph the set of points in the table below.



X	Y
7	5
3	5
0	5
-4	5
-6	5

Using the differences between two sets of X values repeat this step with two sets of Y values. Create two fractions by placing the differences of the Y value over the differences in the X values. What did you discover about the fractions?

5. Choose three linear equations of your own in which one has a positive coefficient in front of X, one has a negative coefficient in front of X, and the third one has zero as the coefficient in front of X. Create a table for each of the equations and graph them. Describe the similarities and difference of the three graphs.



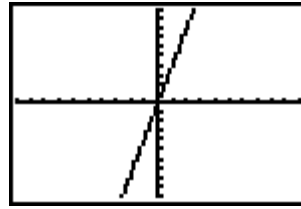
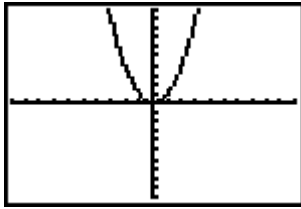
X	Y

X	Y

X	Y

## Homework Activity Worksheet: Key

1.



2.

X	Y
3	9
5	13
0	3
-4	-5
-6	-9

Answers using the following ordered pairs (3,9), (0,3)

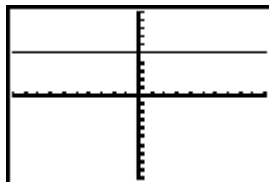
The difference in the X values is  $3 - 0 = 3$ . The difference in the Y values is  $9 - 3 = 6$ . The fraction created by placing the difference in the Y values over the difference in the X values is  $\frac{3}{6}$  or  $\frac{1}{2}$ . Using the ordered pairs

(-4,-5) and (-6,-9) the difference in the values is  $-4 - (-6) = 2$  and the difference in the Y values is  $-5 - (-9) = 4$ . The fraction created by placing the difference in the Y values over the difference in the X values is  $\frac{2}{4}$  or

$\frac{1}{2}$ . Does not matter which set of ordered pairs the students use the answer should always be the same.

3.  $Y = -2X + 3$

4.



5. The graphs and tables will vary depending on the linear equations selected by the students.

## Slopy Math: Module 3

### Teacher's Guide

**Objectives:** The student will be able to:

- define slope/rate of change and the y-intercept.
- write simple linear equations in slope-intercept form to model given graphs by predicting the slope and identifying/estimating the y-intercept of the graph.
- explain how the appearance of a linear graph will change when either the slope or the y-intercept is changed.

**Materials:** If at all possible, students should have at their disposal the completed worksheets from the prior modules in this lesson unit.

Student Worksheets

Assessment Sheet

TI-83/TI-83+ Calculators

**Procedure:** A brief introduction to this lesson should include a review of the CBL lab that was completed in Module 1 and the TI-83+ lab that was completed in Module 2. Either a class discussion could be led by the teacher or the students could be broken into small groups of between two and four students. The discussion should cover what was actually done during each lab and what was discovered in each lab as related to the slope and y-intercept of a linear equation. An actual demonstration involving one or two students up front using one CBL unit would probably be very helpful, especially if these modules are done at separate times. Possible outcomes of the discussions would be:

"The CBL created a graph the modeled walking at different rates of speed heading away from and towards the motion detector. The graph related distance as it related to time and the steepness of the graph changed as we walked at a different rate of speed. When our pace was relatively slow, the graph was flat. As our rate of speed increased, the graph was steeper. Also, when we walked away from the motion detector, the graph appeared to be going up hill, it had a positive correlation, and as we walked towards the motion detector, the graph appeared to be going downhill, it had a negative correlation."

"We entered linear equations into the  $y=$  area of our calculator. When we changed the number in front of  $x$ , the steepness of the line changed. As this number became bigger, the line became steeper. When the number was positive, the graph went 'uphill' and when the number was negative, the graph went 'downhill.' When you changed the number that stood alone, the constant, the graph 'slid' up or down, but the steepness stayed the same."

The worksheet/reference sheet should now be handed out. This allows the students to answer specific questions about how to change the appearance of a graph using the knowledge acquired in the prior two modules and just covered in the discussion. It can then be used as a study guide during classroom activities and while doing homework assignments. Review the answers to all nine questions to ensure students have correct answers on their "study guide." Allow students to ask clarifying questions to ensure they fully understand each question on the worksheet.

The Graph worksheet should now be handed out. **Note: The first page of this worksheet should be copied separately so that the students have use of it to compare to the graphs in the exercise.** This worksheet will informally assess their understanding of slope and the y-intercept and how changes in either one affects a linear graph. The purpose of this exercise is to see if the student can predict the equation of a given graph by using a model graph of the equation  $y = 1x + 0$ . The student will be required to estimate the slope and y-intercept of the given graph using his/her acquired knowledge of slope and y-intercepts. He/she will then use the y = area and graph function of the TI-83 to view his linear graph based on his/her predicted equation and make adjustments to the slope and y-intercept until the created graph matches the given graph. The student should be able to accomplish this task when given graphs with positive and negative slope and positive, negative, or zero y-intercepts. Note: This exercise could be done as a group activity or individually with students being given the opportunity to compare their predicted equations and discuss how they arrived at their answers and come to a conclusion as to which answer is correct. It is suggested that each student have his/her own worksheet so as to have the exercise in his or her notebooks as a reference sheet. Discuss each graph and the correct linear equation for each and how it could have been derived.

Students should now be ready for the assessment. Since this is an introductory unit to a major unit in most curriculums, you might consider administering this in groups two or three students. Otherwise, administer it as an individual quiz. It is suggested that the answers be reviewed with the class to reinforce the concepts.

The intent of this entire unit is to offer an alternative, general introduction to slope, linear equations, and graphing. It is recommended that you will now enter the standard curriculum path as outlined in your county curriculum guide.

**Slopy Math: Module 3**  
**Worksheet/Reference Sheet**

Answer the following questions in full sentences.

- 1.) What is slope?
- 2.) In the equation  $y = ax + b$ , which letter represents slope?
- 3.) What happens when you make the value for slope bigger? smaller?
- 4.) What happens when you make the value for slope 0 (zero)? Make up a linear equation where the slope is 0.
- 5.) Where is the y-intercept on a linear graph?
- 6.) In the equation  $y = ax + b$ , which letter represents the y-intercept?
- 7.) Change the equation so that the graph  $y = 2x + 1$ :  
becomes steeper: \_\_\_\_\_  
changes direction: \_\_\_\_\_  
shifts upward 2 units: \_\_\_\_\_
- 8.) What do the letters x and y represent in a linear equation?
- 9.) In your own words, using full sentences, explain why increasing the number in front of x causes the line to become steeper.

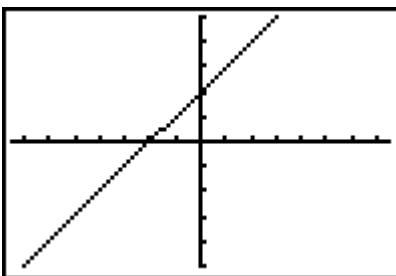
### Slopy Math: Module 3 Graph Worksheet

You are given a sample graph with its equation that has a slope of 1 and a y-intercept of 2. You will use this graph and its equation as a guide to help you write linear equations in the form  $y = ax + b$  to model the graphs in the exercises below. Follow the steps indicated to write the equation for each problem.

- Directions:**
- 1.) Compare the graph to the sample graph.
  - 2.) Predict the slope of the graph realizing that the slope in the sample graph is 1.  
Identify the y-intercept on the graph.  
Write your predicted equation in the 1<sup>st</sup> Guess blank.
  - 3.) Go to the Y = area in your calculator and enter your model equation into  $Y_1 =$ .
  - 4.) Hit [GRAPH] and compare your graph to the graph in the problem.
  - 5.) If your graph does not match the graph in the problem, adjust your slope and/or your y-intercept and compare your "new" graph to the graph in the problem.
  - 6.) Repeat Step 6 until your graph matches the graph in the problem.
  - 7.) Record your final equation in the answer box. You should now have two equations recorded for each problem, your original guess and your final answer. **Your teacher will give you the correct equations during class review.**

#### SAMPLE GRAPH

Equation:  $y = 1x + 2$



**Hint:** As you compare each graph to the sample graph, ask yourself:

1.) **Is the graph steeper than the Sample Graph?**

If so, then the number in front of 'x' must get larger.

2.) **Is the graph not as steep as the Sample Graph?**

If so, then the number in front of 'x' must be smaller,  
a fraction or decimal.

3.) **Did the steepness of the graph change direction from the Sample Graph?**

If so, change the sign of the number in front of 'x'.

4.) **Did the entire graph move up compared to the Sample Graph?**

If so, then make the constant (the y-intercept) bigger.

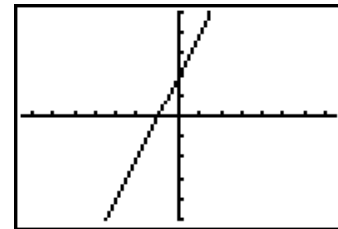
5.) **Did the graph move down compared to the Sample Graph?**

If so, then make the constant smaller, maybe even negative.

1.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

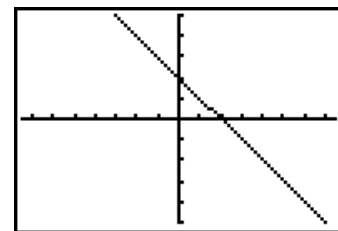
Actual Equation \_\_\_\_\_



2.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

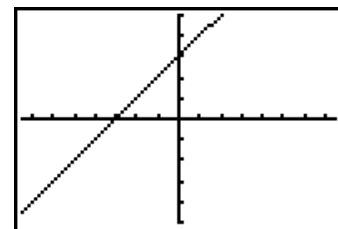
Actual Equation \_\_\_\_\_



3.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

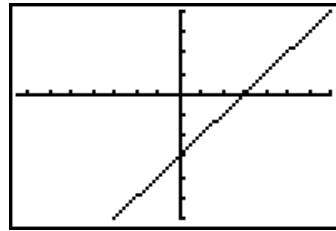
Actual Equation \_\_\_\_\_



4.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

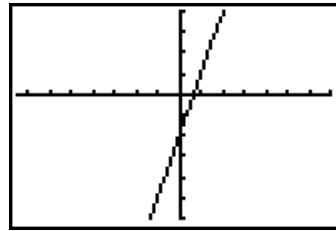
Actual Equation \_\_\_\_\_



5.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

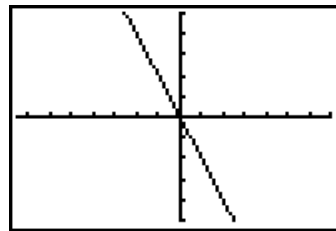
Actual Equation \_\_\_\_\_



6.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

Actual Equation \_\_\_\_\_

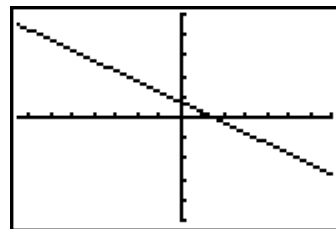


### Challenger Graph

7.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

Actual Equation \_\_\_\_\_



**Slopey Math: Module 3**  
**Quiz**

**Write your answers in full sentence form.**

- 1.) Define the slope and the y-intercept as it relates to linear graphs.

Slope is \_\_\_\_\_.

The y-intercept is \_\_\_\_\_.

- 2.) Identify the slope and the y-intercept in:  $y = 5x - 4$ .

HINT: Be careful with the sign of the y-intercept.

Slope = \_\_\_\_\_

y-intercept = \_\_\_\_\_

- 3.) How does the appearance of the graph change when the slope becomes larger?

- 4.) What happens to the graph when the y-intercept increases or decreases?

- 5.) How do we know when x and y represent a solution to a linear equation? You may include in your answer an explanation how x and y relate to each other.

HINT: Think of them as an ordered pair, ( x, y ).

Go to the Window area on the calculator and change your window so it matches the window settings you see here:

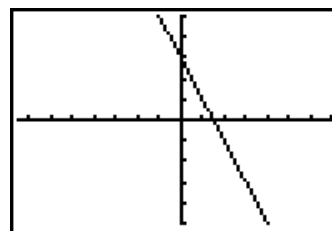
```
WINDOW
Xmin=-7.5
Xmax=7
Xscl=1
Ymin=-5
Ymax=5
Yscl=1
Xres=1
```

6.) Write the equation that represents this graph:

HINT: Use the y = area of the calculator to input your "guess" and adjust your equation until the graph on your screen matches the graph you see here.

Your equation to this graph is:

\_\_\_\_\_



Explain below all of the steps that you used to determine the equation of the line. Remember to use complete sentences.

**Slopy Math: Module 3**  
**Worksheet/Reference Sheet: Key**

Answer the following questions in full sentences.

- 1.) What is slope?

*Example: Slope is the steepness of a line.*

- 2.) In the equation  $y = ax + b$ , which letter represents slope?

*Slope is represented by 'a'.*

- 3.) What happens when you make the value for slope bigger? smaller?

*Example: When slope gets bigger the graph becomes steeper.*

*When slope gets smaller the graph becomes less steep.*

- 4.) What happens when you make the value for slope 0 (zero)? Make up a linear equation where the slope is 0.

*Example: When the slope is zero, the graph is a horizontal line.*

- 5.) Where is the y-intercept on a linear graph?

*Example: The y-intercept is the y value where the line crosses the y-axis.*

- 6.) In the equation  $y = ax + b$ , which letter represents the y-intercept?

*The y-intercept is represented by 'b'.*

- 7.) Change the equation so that the graph  $y = 2x + 1$ :

becomes steeper:  $y = 4x + 1$

changes direction:  $y = -2x + 1$

shifts upward 2 units:  $y = 2x + 3$

- 8.) What do the letters x and y represent in a linear equation?

*Example: Solutions to the equation. When x is substituted into the equation, the answer is y.*

- 9.) In your own words, using full sentences, explain why increasing the number in front of x causes the line to become steeper.

*Example: Because the value for x is being doubled or tripled, so the answer goes up faster.*

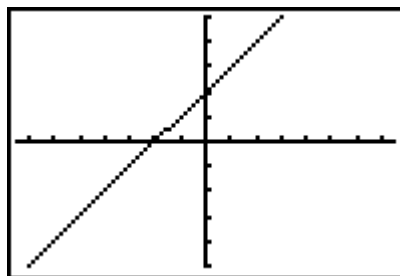
### Slope Math: Module 3 Graph Worksheet: Key

You are given a sample graph with its equation that has a slope of 1 and a y-intercept of 2. You will use this graph and its equation as a guide to help you write linear equations in the form  $y = ax + b$  to model the graphs in the exercises below. Follow the steps indicated to write the equation for each problem.

- Directions:**
- 1.) Compare the graph to the sample graph.
  - 2.) Predict the slope of the graph realizing that the slope in the sample graph is 1.  
Identify the y-intercept on the graph.  
Write your predicted equation in the 1<sup>st</sup> Guess blank.
  - 3.) Go to the  $Y =$  area in your calculator and enter your model equation into  $Y_1 =$ .
  - 4.) Hit [GRAPH] and compare your graph to the graph in the problem.
  - 5.) If your graph does not match the graph in the problem, adjust your slope and/or your y-intercept and compare your "new" graph to the graph in the problem.
  - 6.) Repeat Step 6 until your graph matches the graph in the problem.
  - 7.) Record your final equation in the answer box. You should now have two equations recorded for each problem, your original guess and your final answer. **Your teacher will give you the correct equations during class review.**

#### SAMPLE GRAPH

Equation:  $y = 1x + 2$



**Hint:** As you compare each graph to the sample graph, ask yourself:

1.) **Is the graph steeper than the Sample Graph?**

If so, then the number in front of 'x' must get larger.

2.) **Is the graph not as steep as the Sample Graph?**

If so, then the number in front of 'x' must be smaller,  
a fraction or decimal.

3.) **Did the steepness of the graph change direction from the Sample Graph?**

If so, change the sign of the number in front of 'x'.

4.) **Did the entire graph move up compared to the Sample Graph?**

If so, then make the constant (the y-intercept) bigger.

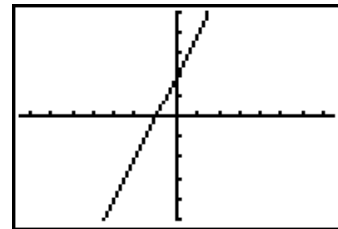
5.) **Did the graph move down compared to the Sample Graph?**

If so, then make the constant smaller, maybe even negative.

1.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

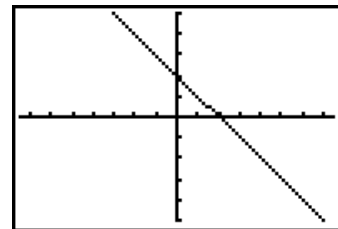
Actual Equation  $y = 2x + 2$



2.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

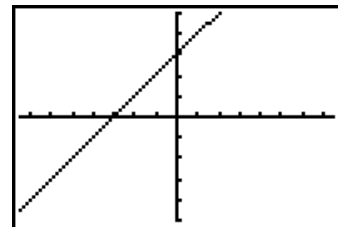
Actual Equation  $y = -x + 2$



3.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

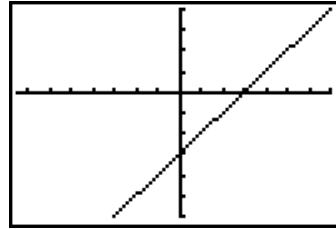
Actual Equation  $y = x + 3$



4.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

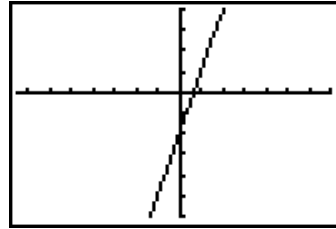
Actual Equation  $y = x - 3$



5.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

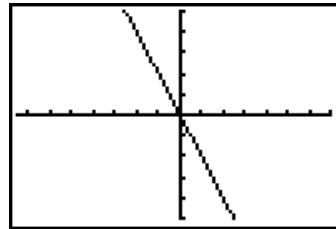
Actual Equation  $y = 3x - 2$



6.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

Actual Equation  $y = -2x + 0$

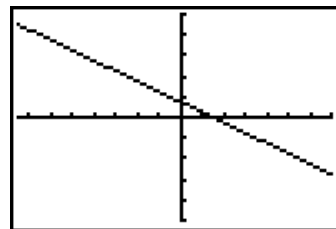


### Challenger Graph

7.) 1<sup>st</sup> Guess \_\_\_\_\_

Final Guess \_\_\_\_\_

Actual Equation  $y = -.5x + .75$



**Slopey Math: Module 3**  
**Quiz: Key**

**Write your answers in full sentence form.**

- 1.) Define the slope and the y-intercept as it relates to linear graphs.

Slope is *the steepness of a line*.

The y-intercept is *the y value where the graph crosses the y-axis*.

- 2.) Identify the slope and the y-intercept in:  $y = 5x - 4$ .  
HINT: Be careful with the sign of the y-intercept.

Slope = 5                      y-intercept = -4

- 3.) How does the appearance of the graph change when the slope becomes larger?

*Example: The line becomes steeper.*

- 4.) What happens to the graph when the y-intercept increases or decreases?

*Example: The graph shifts up or down, but the steepness stays the same.*

- 5.) How do we know when x and y represent a solution to a linear equation? You may include in your answer an explanation how x and y relate to each other.  
HINT: Think of them as an ordered pair, (x , y).

*Example: When you substitute the values of x and y into the equation the equation is true.*

Go to the Window area on the calculator and change your window so it matches the window settings you see here:

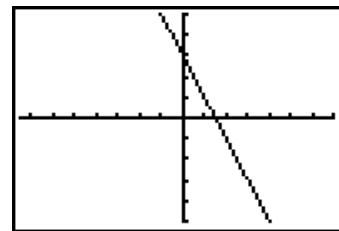
```
WINDOW
Xmin=-7.5
Xmax=7
Xscl=1
Ymin=-5
Ymax=5
Yscl=1
Xres=1
```

6.) Write the equation that represents this graph:

HINT: Use the y = area of the calculator to input your "guess" and adjust your equation until the graph on your screen matches the graph you see here.

Your equation to this graph is:

$$y = -2x + 3$$



Explain below all of the steps that you used to determine the equation of the line. Remember to use complete sentences.

*Example: First I compared the graph with the sample graph. I substituted my guess for slope, -2, in for 'a'. I saw that the graph crossed the y-axis at 3 and so I substituted 3 in for 'b'. My final equation was  $y = -2x + 3$ . I put this into the Y= area of the calculator, hit graph, and compared my graph with the one on the quiz. They were the same.*